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Optimization of *Zakat* Management Based on Ethereum Blockchain and Its Impact on Cost Efficiency

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Abstract

Zakat is a fundamental component of Islamic social finance, intended to reduce inequality and strengthen community welfare. However, traditional zakat systems face recurring issues, including inefficiency, lack of transparency, and low public trust. This study aims to optimize zakat management using Ethereum blockchain technology, particularly the Layer 2 (Base) network, with a focus on its impact on cost efficiency and system transparency. Using a qualitative-descriptive approach, the research designs and simulates a blockchain-based zakat distribution model that incorporates smart contracts for automated fund allocation to eight categories of ashnaf, along with off-chain verification for Sharia compliance. A simulation of USDC 1,000 zakat fund distribution demonstrates that the blockchain system ensures accurate, traceable, and tamper-proof transactions, while reducing transaction costs by over 98% compared to conventional methods. Smart contracts automate the disbursement process, while all transaction records are stored on a public ledger, which supports real-time auditing and enhances institutional accountability. These results demonstrate that the integration of blockchain technology not only improves operational efficiency and transparency but also supports Islamic legal and ethical governance. In conclusion, this model provides a practical and scalable framework for modernizing zakat management with a strong emphasis on cost efficiency, public trust, and Sharia compliance.

Keywords: *Digital Zakat, Blockchain, Ethereum Layer 2, Smart Contract*

Introduction

Zakat is one of the five pillars of Islam that every capable Muslim is required to fulfill. Broadly, zakat is categorized into two types: *zakat fitrah*, which is a compulsory *zakat* given during *Ramadhan*, and *zakat maal*, which pertains to accumulated wealth and is the focus of this study. Beyond its religious significance, *zakat* acts as a socio-economic instrument to promote equity and solidarity by redistributing wealth from the affluent (*muzakki*) to the needy (*mustahiq*).[1] Its role is not limited to meeting basic needs such as food and healthcare, but also contributes to long-term poverty alleviation and social empowerment in Muslim communities.

The Qur'an affirms the obligation of *zakat* in Surah al-Baqarah (2): 43 and at-Taubah (9): 60. These verses emphasize not only the spiritual importance of *zakat* but also the social responsibility of Muslims towards the needy, including the poor, *zakat* managers, and the eight designated recipient groups.[2] This underlines that *zakat* is

[1] Windi Wulandari Fitirani and Noven Suprayogi, "Analisis Meta: Determinan Minat Muzakki Membayar Zakat ke Organisasi Pengelola Zakat," *Islamic Economics Journal*, Vol. 9, No. 1, (2023), 19–34, https://ejournal.unida.gontor.ac.id/index.php/JEI/article/view/8771%0Ahttps://ejournal.unida.gontor.ac.id/index.php/JEI/article/download/8771/10793.

[2] Rini Elvira, *et. al.*, "Good Amil Governance in Zakat Management in West Sumatra," *Indonesian Interdisciplinary Journal of Sharia Economics (IIJSE)*, Vol. 7, No. 1, (2024), 163–89.

not only a personal act of worship but also a social empowerment instrument that must be managed seriously and professionally.

Poverty remains a persistent issue in many developing countries, including Indonesia. Each year, poverty statistics serve as a critical indicator in measuring national economic development.[3] As a country with a large population and ongoing development, Indonesia faces several challenges such as unequal income distribution, limited job opportunities, and low financial literacy among the public. The success of economic development is not solely measured by growth rates but also by a country's ability to reduce poverty through equitable wealth distribution.[4]

In the management of *zakat* and other social funds, the presence of a reliable accounting system is essential.[5] A transparent accounting system ensures that all processes from collection to management and distribution are conducted accountably and efficiently.[6] This is important for building public trust in *zakat* institutions and ensuring that funds reach the rightful recipients. Professionally managed finances also support good governance and encourage broader community participation.

Zakat has also been integrated into the national taxation system. According to Law No. 17 of 2000 concerning Income Tax, Article 4, Paragraph 3, *zakat* payments made through official institutions are deductible from taxable income.[7] This regulation provides benefits for both companies and individuals who formally fulfill their *zakat* obligations, without increasing financial burdens.[8] Corporate philanthropy through *zakat* represents a tangible contribution from the business sector to sustainable social development aligned with Islamic economic principles.

Indonesia, with over 230 million Muslims, holds tremendous *zakat* potential. According to BAZNAS (2023), the annual *zakat* potential in Indonesia exceeds Rp. 327 trillion, yet actual collections remain below 5% of this estimate. Globally, *zakat* potential may surpass USD 300 billion annually (World Bank, 2022), highlighting the untapped capacity of Islamic social finance. Despite institutional growth and improved awareness, the collection gap remains substantial. In response, technological innovations such as digital banking, Islamic Fintech, and blockchain have gained traction. As noted by Zulfikri, *et. al.* (2021) and Halik, *et. al.* (2025), blockchain

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[3] Sulistiara Putri, *et. al.*, "Integrasi Teknologi Blockchain Dalam Keuangan Syariah: Tinjauan Literatur Atas Solusi Desentralisasi Yang Sesuai Syariah," *Jurnal Akuntansi, Keuangan, Perpajakan dan Tata Kelola Perusahaan,* Vol. 2, No. 4, (2025), 1134–40, https://doi.org/10.70248/jakpt.v2i4.2370.

[4] Muhammad Yazid and Aji Prasetyo, "Sharia Social Capital Construction in Strengthening the Community Economy by National Zakat Agency Institutions Yatim Mandiri Surabaya," *Indonesian Interdisciplinary Journal of Sharia Economics (IIJSE),* Vol. 7, No. 3, (2024), 5252–63.

[5] Fikri Iskandar fatkhurohman, "Strategi Fundraising Zakat Profesi (Studi Kasus Baitul Maal Hidayatullah Ponorogo)," *Journal of Islamic Economics and Philanthropy,* Vol. 5, No. 1 (2022), 14, https://doi.org/10.21111/jiep.v5i1.6081.

[6] Bagas Aulia, Kamilah, and Yenni Samri Juliati Nasution, "Strategy of the Takmir of the Great Mosque of the Cubadak Market Recording and Accountability of Sharia Finances," *Indonesian Interdisciplinary Journal of Sharia Economics,* Vol. 8, No. 1, (2025), 956–78.

[7] Ines Nathasia Oktaviani, Salim Alaidrus, and Siswanto, "The Influence of Qard and Zakat on Profitability of Islamic Banks in Indonesia," *Indonesian Interdisciplinary Journal of Sharia Economics (IIJSE),* Vol. 5, No. 1, (2022), 63–73, https://doi.org/10.31538/iijse.v5i1.1968.

[8] M. Kabir Hassan, *et. al.*, "Convergence in Islamic Financial Development: Evidence from Islamic Countries Using the Fourier Panel KPSS Stationarity Test," *Borsa Istanbul Review,* Vol. 23, No. 6, (2023), 1289–1302, https://doi.org/10.1016/j.bir.2023.09.006.

technology provides transparency, real-time auditability, and automation, which are crucial in increasing *muzakki* trust and optimizing *zakat* distribution under Sharia principles.

Blockchain has become a prominent topic in modern accounting and finance. This technology offers a decentralized, transparent, and tamper-resistant record-keeping system.[9] Accountants and financial professionals need to understand how blockchain works, as it can transform how financial information is recorded, reported, and communicated.[10] Blockchain addresses the three core aspects of security: data availability, confidentiality, and transaction integrity.[11] It brings new hope for managing *zakat* in a more trustworthy and efficient manner, especially at scale.[12]

Beyond being a tool for wealth distribution, *zakat* plays a crucial role in empowering the community's economy. Through productive *zakat* programs, collected funds are not only distributed for consumption but also allocated to support micro-enterprises, skill training, and local economic development.[13] This impacts not only the well-being of *mustahiq* (beneficiaries) but also fosters healthier economic circulation at the community level. Nevertheless, challenges remain, particularly regarding the transparency of fund distribution, program effectiveness, and monitoring long-term impact. Therefore, effective *zakat* management requires a combination of spiritual, social, technological, and modern governance approaches.[14]

In simple terms, blockchain is a distributed ledger technology that enables transactions to be processed without the need for third-party involvement.[15] Conceptually, several studies have explored blockchain-based *zakat* models; however, this research differs in that it tailors an existing system to meet the specific needs of *zakat* institutions in Indonesia. This study aims to analyze whether *zakat* management institutions require a blockchain-based *zakat* system to enhance transparency in fund management, which may lead to increased donations collected from *muzakki*.[16]

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[9] Verdianti, Rahma Yulisa Kalbarini, and Nur Atiqah, "ZIS Management and Accountability in the Era of Digitalization in West Kalimantan LAZ," *Indonesian Interdisciplinary Journal of Sharia Economics (IIJSE),* Vol. 7, No. 1, (2024), 782–800, https://e-journal.uac.ac.id/index.php/iijse/article/view/4466%0Ahttps://e-journal.uac.ac.id/index.php/iijse/article/download/4466/1564.

[10] Muhammad Zacky Dzulfikar, Purbayu Budi Santosa, and Eddy Yusuf Agung Gunanto, "Analysis of Millennial Muslims Preferences on the Crowdfunding Platform," *Indonesian Interdisciplinary Journal of Sharia Economics (IIJSE),* Vol. 5, No. 1, (2022), 24–47, https://doi.org/10.31538/iijse.v5i1.1796.

[11] I Nyoman Agus Wijaya, Sinta Setiana, and Finna Rusyana, "Profesional Skeptimisme Auditor dan Kualitas Audit dalam Era Blockchain (Auditor Professional Skepticism and Audit Quality in The Blockchain Era)," *Akuntansi Bisnis & Manajemen (ABM),* Vol. 30, No. 2, (2023), https://doi.org/10.35606/jabm.v30i2.1278.

[12] Clara Amalia Ismayanti and Parma Hadi Rantelinggi, "Simulasi Penggunaan Blockchain pada Keamanan Jaringan Internet of Things Menggunakan Pin Emulator: Model Public Blockchain," *Jurnal Teknologi Informasi dan Ilmu Komputer,* Vol. 11, No. 2, (2024), 235–42, https://doi.org/10.25126/jtiik.20241126108.

[13] Ichsan Hamidi, *et. al.,* "Determinant of Zakat Productive Towards Small Medium Enterprise (SMEs) Incomes of Recipient of Zakat," *Islamic Economics Journal,* Vol. 7, No. 1, (2021), 18, https://doi.org/10.21111/iej.v7i1.5176.

[14] Morris Altman, "The Impact of Cooperatives on Local Economic Resilience," *Journal of Rural Studies*, Vol. 76, No. 2, (2020), 102–15.

[15] Thúy Vân, "Blockchain and Electronic Health Records Security in Hospitals," Vol. 2, No. 2, (2025), 52–67.

[16] Nurul Ikhsan, "Blockchain Zakat in Zakat Management Organizations, Is It Necessary?," *Journal of Enterprise and Development* Vol. 5, No. 3, (2023), 317–30, https://doi.org/10.20414/jed.v5i3.7043.

Literature Review

Zakat and Its Management from a Sharia Perspective

Zakat is the third pillar of Islam and is obligatory for every capable Muslim. It plays a vital role in promoting economic equality and eradicating poverty.[17] The function of *zakat* is not only spiritual but also social and economic, as *zakat* funds are used to support eight categories of eligible recipients (*mustahiq*), as stated in Surah at-Taubah, verse 60 of the Qur'an. In practice, *zakat* management must adhere to Sharia principles such as justice, transparency, and accountability. Justice is realized through targeted fund distribution, transparency is reflected in the openness of information to *muzakki* (*zakat* payers) and the public, and accountability involves the institution's responsibility for clearly reporting the use of *zakat* funds.[18]

Zakat Management Institutions (LAZ) are entrusted with a strategic role in collecting, verifying, and distributing *zakat* funds. However, in practice, many LAZs face operational efficiency challenges and issues in maintaining public trust. Therefore, in line with the times, modernizing *zakat* systems has become increasingly necessary. Digital innovations, including online platforms and blockchain technology, are being developed to address these challenges.[19] Technologies like smart contracts on the Ethereum network enable the automated collection and distribution of *zakat*, ensuring that all transactions are permanently recorded on a public blockchain. This not only improves operational efficiency and reduces transaction costs but also enables real-time audit access for the public, thus reinforcing transparency and accountability in *zakat* management.[20] Several studies have indicated that blockchain-based *zakat* digitalization can serve as a strategic solution to optimize *zakat* management in a modern, efficient, and Sharia-compliant manner.[21]

Digital Zakat

Digital *zakat* refers to a *zakat* management system that utilizes information and communication technology to enable *muzakki* (*zakat* payers) to make payments and reports online.[22] The digital transformation of *zakat* management, particularly through the application of blockchain technology, represents a significant advancement in the efficiency, transparency, and accountability of *zakat* institutions.[23] This digital

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[17] Ichsan Hamidi, Muhammad Farhan, and Deassy Apriani, "Investment, ZIS Funds, Mudharabah Financing and Economic Growth in Indonesia," *Islamic Economics Journal*, Vol. 10, No. 1, (2024), 45–60, https://doi.org/10.21111/iej.v10i1.11990.

[18] Muhammad Nur Aqmal Bin Khatiman, Muhammad Salikin Bin Ismail, and Norzariyah Yahya, "Blockchain-Based Zakat Collection to Overcome the Trust Issues of Zakat Payers," *International Journal on Perceptive and Cognitive Computing (IJPCC),* Vol. 7, No. 1, (2021), 1.

[19] Arva Athallah Susanto, *et. al.,* "Digital Transformation in Zakat Management: A Bibliometric Review on the Application of Blockchain Technology," *IBAF E-Proceedings,* Vol. 11, No. 1, (2024), 768–90, https://doi.org/10.33102/7qjfd415.

[20] Chita Ayu and Astari Putri, "Exploring the Potential of Blockchain Technology for Zakat Administration in Indonesia," *International Journal of Zakat,* Vol. 6, No. 3 (2021), 2021–2101.

[21] Muhammad Fariz Baiquni and Raden Teduh Dirgahayu, "Aplikasi Terdesentralisasi Berbasis Blockchain dan Smart Contract untuk Pengelolaan Zakat," *Automata,* Vol. 4, No. 2, (2023), 1–10, https://journal.uii.ac.id/AUTOMATA/article/view/28628.

[22] Amir Ma'ruf, "Efektivasi Pengumpulan Zakat di Kabupaten Sumbawa Barat," *Islamic Economics Journal,* Vol. 8, No. 1, (2022), 57, https://doi.org/10.21111/iej.v8i1.7060.

[23] Susanto, *et. al.,* "Digital Transformation in Zakat Management: A Bibliometric Review on the Application of Blockchain Technology."

implementation offers numerous benefits, including improved accessibility for communities in remote areas, faster fund allocation processes, and significant operational cost efficiency. For example, a study on BAZNAS Tangerang City revealed that digitalization of *zakat* collection successfully reduced processing time and administrative costs while expanding *zakat* outreach to millennials and mobile users.[24]

However, most digital *zakat* platforms still rely on centralized systems, which creates risks of data manipulation and limited transparency for the public. To address these issues, decentralized technologies such as blockchain, particularly Ethereum, have been proposed.[25] Smart contracts can automate *zakat* distribution once predefined conditions are met, and all transaction data is permanently recorded on an immutable public ledger. A conceptual study by Zulfikri, *et. al.*, (2023) emphasizes that blockchain facilitates transparent, secure, and auditable systems, thus increasing *muzakki*'s trust in *zakat* institutions.[26] Furthermore, a systematic analysis by Nurul Widyawati et al. (2025) asserts that blockchain-based digital *zakat* design supports real-time fund monitoring, enhances operational efficiency of *zakat* institutions, and promotes greater public accountability. Therefore, although digital *zakat* has made significant progress, decentralized technology innovations such as Ethereum are essential to address existing gaps in transparency and security, and to further advance *zakat* digitalization towards optimal Sharia and public compliance.[27]

Blockchain and Ethereum in Islamic Financial Systems

Blockchain is a decentralized technology that enables permanent, transparent, and secure data recording without the involvement of third parties, making it highly relevant for financial systems that require strong integrity and accountability, such as *zakat* management. This study discusses Financial Technology (Fintech) as an emerging innovation that offers financial services through digital platforms.[28] Ethereum, one of the most widely used blockchain platforms, is capable of executing smart contracts, digital agreements that automatically perform specific tasks based on predefined parameters without manual intervention. In the context of Islamic finance, Ethereum offers significant potential to support the principles of justice, transparency, and public trust, as all transactions are openly recorded and immutable.

This is supported by the findings of Rohmah, *et. al.* (2022), which state that integrating smart contracts into *zakat* systems can accelerate fund distribution and reduce the risk of misappropriation.[29] Furthermore, the use of stablecoins such

[24] Abdul Chadjib Halik, Idris Parakkasi, and Rika Dwi Ayu Parmitasari, "Blockchain dan Keuangan Sosial Islam: Merevolusi Zakat dan Wakaf untuk Distribusi Kesejahteraan Sosial Yang Lebih Transparan," *Jurnal Cendekia Ilmiah,* Vol. 4, No. 3, (2025), 575–84.

[25] Adib Fachri and Citra Etika, "Optimization of Zakat Fundraising Realisation Based on the Measurement of the Zakat Literacy Index in Rural and Urban Communities," *Islamic Economics Journal,* Vol. 10, No. 2, (2024), 163–83, https://doi.org/10.21111/iej.v10i2.12975.

[26] Zulfikri, Salina Hj Kassim, and Weni Hawariyuni, "Proposing Blockchain Technology Based Zakat Management Model to Enhance Muzakki's Trust in Zakat Agencies: A Conceptual Study," *Journal of Accounting Research, Organization and Economics,* Vol. 4, No. 2 (2021), 153–63, https://doi.org/10.24815/jaroe.v4i2.20467.

[27] Ma'ruf, "Efektivasi Pengumpulan Zakat di Kabupaten Sumbawa Barat."

[28] Fahrur Rozi, Sri Wahyuni Safitri AR, and K Rochayatun, "Peran Financial Technology (Fintech) Syariah dalam Perekonomian Negara di Indonesia," *Jurnal Ilmiah Ekonomi Islam*, Vol. 10, No. 2, (2024), 1668–74.

[29] Hartomi Maulana, Soritua Ahmad Ramdani Harahap, and Mentari Mentari Fazrinnia, "Analysis of

as USD Coin (USDC) within the Ethereum ecosystem helps maintain transaction value stability. It mitigates cryptocurrency volatility, aligning it more closely with the principle of prudence in Sharia. A study by Zulfikri, *et. al.,* (2023) shows that Ethereum-based stablecoins can optimize *zakat* distribution accurately and efficiently via Layer 2 networks with very low transaction costs. Additionally, Ethereum has transitioned to a proof-of-stake consensus mechanism, which significantly reduces energy consumption by up to 99%, thereby supporting the *maqashid sharia* principle of environmental preservation.[30] With these advantages, Ethereum stands out as an up-and-coming technological solution for modernizing digital *zakat* management, offering efficiency, security, and Sharia-compliance.[31]

Smart Contracts and the Automation of Zakat Distribution

Smart contracts on the blockchain are designed to execute transactions automatically without the need for human intervention, based on predefined conditions for example, disbursing *zakat* funds once *mustahiq* verification data is declared valid.[32] In a digital *zakat* system built on Ethereum, smart contracts can ensure direct fund distribution to *eligible wallets once the requirements are met, thereby increasing the speed of distribution* and minimizing the risk of fund misappropriation. Baiquni (2023) emphasizes that implementing smart contracts within decentralized applications (DApps) for *zakat* management on the Ethereum platform can enhance *zakat* monitoring and reporting processes. Multiple stakeholders, such as *muzakki*, *zakat* institutions (LAZ), and government authorities, can track the entire flow of funds in real time.

Additionally, a study published on Research Gate concludes that smart contracts can accelerate *zakat* fund transfers, prevent manual errors, and significantly reduce material costs and processing time.[33] Therefore, the integration of smart contracts into digital *zakat* systems demonstrates great potential in enhancing distribution efficiency, reinforcing accountability, and expanding public audit access, an essential advancement for modern, trustworthy Sharia-compliant *zakat* governance.

Cost Efficiency Through Ethereum Layer 2

One of the main challenges in adopting public blockchain technology is the high transaction cost, or gas fee, which can be burdensome for *zakat* institutions, especially in developing countries like Indonesia.[34] However, Layer 2 solutions, such

Strategic Risk Management on National Board of Zakat (BAZNAS) in Sukabumi," *Islamic Economics Journal,* Vol. 8, No. 2, (2022), 172, https://doi.org/10.21111/iej.v8i2.8787.

[30] Mulia Fajri Ningsih, *et. al.*, "Peran Teknologi Blockchain dalam Meningkatkan Transparansi dan Akuntabilitas Pengelolaan Zakat," *CITIZEN:Jurnal Ilmiah Multidisiplin Indonesia,* Vol. 4, No. 2, (2024), 87–94, https://doi.org/10.53866/jimi.v4i2.542.

[31] Iskandar fatkhurohman, "Strategi Fundraising Zakat Profesi (Studi Kasus Baitul Maal Hidayatullah Ponorogo)."

[32] Rahasia Taufiqi Al Ayyubi, "Pengaruh Distribusi Zakat, Infaq, Sedekah dan CSR Terhadap Penurunan Ketimpangan Sosial," *Islamic Economics Journal,* Vol. 7, No. 2, (2021): 135, https://doi.org/10.21111/iej.v7i2.6538.

[33] Sapri Ali and Azzafa Nur Jadidah, "Peran Teknologi dalam Optimalisasi Pengumpulan dan Distribusi Zakat dan Wakaf," *El-Faqih : Jurnal Pemikiran dan Hukum Islam,* Vol. 10, No. 2, (2024), 400–414, https://doi.org/10.58401/faqih.v10i2.1495.

[34] Adamu Abubakar Muhammad, *et. al.,* "Relevance of Zakat and Waqf Models to Achieve Sustainable Development Goals of Water and Sanitation in North Eastern Nigeria," *Islamic Economics Journal,* Vol. 9, No. 2,

as the Base network on Ethereum, offer drastic reductions in transaction fees and significantly improved processing speeds. Layer 2 operates by processing transactions off-chain before consolidating them onto Layer 1, thereby reducing gas costs and network load. A study by Fathoni and Sari (2023) suggests that implementing Layer 2 in digital *zakat* systems can reduce operational costs by up to 98%, making it a strategic solution for institutions seeking to be efficient without compromising transparency and security.

Furthermore, the journal the role of Blockchain Technology for *zakat* Institutions in Indonesia (Zulfikri, 2021), emphasizes that Layer 2 enhances tracking and auditing processes, as transactions are faster and more cost-effective, allowing *zakat* donations to be distributed in real-time with verifiable records on the public ledger.[35] Thus, Ethereum's Layer 2 technology presents a tangible opportunity to develop a digital *zakat* system that is cost-effective, fast, and remains aligned with Sharia principles in managing public funds.

Previous Research

Recent studies have increasingly explored the optimization of *zakat* management through technological innovation, particularly the use of blockchain to enhance transparency, cost efficiency, and Sharia compliance.[36] Confirm that blockchain-based zakat systems are legally permissible in Indonesia, as long as they conform to Islamic law and national regulations, thereby providing a strong normative basis for their adoption.[37] This is further supported by demonstrating how blockchain offers decentralization, transparency, and reduced operational costs in *zakat* management organizations, making it a promising solution to improve institutional performance.

From a technical implementation perspective, Baiquni and Dirgahayu (2023) developed a decentralized *zakat* application (DApp) on the Ethereum blockchain. Their system automates fund disbursement to *ashnaf* and enhances real-time monitoring, showing that blockchain integration can significantly improve *zakat* distribution efficiency.[38] Similarly, present a conceptual framework in which blockchain enables secure, tamper-proof, and transparent transaction systems suitable for long-term *zakat* governance.

In terms of its impact on public trust and accountability, blockchain technology demonstrates that it enhances transparency and auditability in *zakat* institutions, particularly in the distribution process involving the eight *ashnaf* categories.[39] This

(2023), 187–98, https://ejournal.unida.gontor.ac.id/index.php/JEI/article/view/10473%0Ahttps://ejournal.unida.gontor.ac.id/index.php/JEI/article/download/10473/11138.

[35] Issn Online, "Peran Teknologi Blockchain untuk Institusi Zakat di Indonesia," *AGHNIYA: Jurnal Ekonomi Islam,* Vol. 3, No. 2, (2021), 236–42, https://doi.org/10.30596/aghniya.v3i2.8912.

[36] Ayu Rahayu Nurhalizah, Sirajul Arifin, and Aldi Khusmufa Nur Iman, "The Legality of Zakat Blockchain in Indonesia: In the Perspective of Islamic Law and Indonesian Positive Law," *Laa Maisyir: Jurnal Ekonomi Islam,* Vol. 8, No. 2, (2021), 224, https://doi.org/10.24252/lamaisyir.v8i2.22260.

[37] Ningsih, *et. al.,* "Peran Teknologi Blockchain dalam Meningkatkan Transparansi dan Akuntabilitas Pengelolaan Zakat."

[38] Zulfikri, *et. al.,* "Trust Enhancement in Zakat Institutions Using Blockchain Technology: A Qualitative Approach," *EJIF (European Journal of Islamic Finance)*, 2022, 31–36, https://doi.org/10.13135/2421-2172/6312.

[39] Khalida Urfiyya, "Digital System Blockchain Sebagai Strategi untuk Optimalisasi Pengelolaan Dana Zakat: Studi Konseptual," *Jurnal Studi Agama dan Masyarakat,* Vol. 17, No. 2, (2021), 83–95, https://doi.org/10.23971/jsam.v17i2.3157.

aligns with findings by Zulfikri, *et. al.*, (2022), who emphasize the potential of smart contracts to automatically and securely execute *zakat* disbursement, thereby improving trust and reducing the risk of human error or manipulation.[40]

Moreover, Wahyudi, *et. al.*, (2023) argue that blockchain integration not only increases *zakat* distribution efficiency but also supports broader economic development by ensuring funds reach productive recipients in a timely and verifiable manner.[41] Complementing this, Putri (2022) shows through survey and interview data that both *muzakki* and *zakat* officials support blockchain implementation, citing improved transparency, credibility, and trust as key motivations for adopting the technology.

These studies collectively highlight the transformative potential of blockchain in creating more accountable, efficient, and Sharia-compliant *zakat* systems, thereby forming a solid foundation for further model development and practical implementation in Indonesia and beyond.[42]

Methodology

This study employs a descriptive qualitative approach focused on the design and simulation of a digital *zakat* system based on blockchain technology. The main objective is to evaluate the efficiency, transparency, and Sharia compliance of the system through the use of smart contracts on the Ethereum Layer 2 (Base) network. Data sources consist of primary data derived from technical simulations, and secondary data obtained from blockchain documentation, previous literature, and *zakat* governance guidelines.

The qualitative analysis follows a structured sequence, beginning with the design of the digital *zakat* system flow starting from *muzakki* accessing the platform, calculating *zakat* obligations, executing payment via digital wallet, to receiving funds by *mustahiq*. This flow is modeled and visualized using system diagrams and supported by a smart contract script, which is tested and deployed in the Base testnet environment. Each transaction is designed to be automatically recorded and distributed across the eight *ashnaf* categories in accordance with Islamic legal standards. Before distribution, the off-chain verification of *mustahiq* is conducted by certified *zakat* institutions as a control mechanism to ensure religious compliance.

A simulation scenario is then conducted using a sample donation of US$1,000 in USDC, which is distributed proportionally across eight *mustahiq* categories. Each *ashnaf* is assigned a dedicated wallet address, and the smart contract executes automated disbursements. Through this process, the effectiveness, automation, and auditability of the system are observed and evaluated thematically. To strengthen the analysis, a comparative cost estimation is included. Transaction (gas) fees on Ethereum Layer 1 (Mainnet) and Layer 2 (Base) are calculated in real-time using blockchain data. The results demonstrate a reduction in transaction costs by over 98%,

[40] Hassan, *et. al.*, "Convergence in Islamic Financial Development: Evidence from Islamic Countries Using the Fourier Panel KPSS Stationarity Test."

[41] Ma'ruf, "Efektivasi Pengumpulan Zakat di Kabupaten Sumbawa Barat."

[42] Nurul Azizah Az zakiyyah, Indanazulfa Qurrota A'yun, and Firsty Ramadhona Amalia Lubis, "Comparative Trade Analysis Between Indonesia and Organization Islamic Country," *Islamic Economics Journal*, Vol. 8, No. 2, (2022), 98, https://doi.org/10.21111/iej.v8i2.7316.

indicating substantial economic benefits for large-scale institutional implementation. This quantitative comparison is presented to reinforce the argument for blockchain's operational efficiency in managing *zakat*.

All transaction records are stored on a public blockchain ledger, enabling independent verification via blockchain explorers, thereby increasing transparency, institutional accountability, and public trust. This method follows an exploratory simulation framework in line with contemporary research design standards (Bryman & Bell, 2021), and applies a basic cost estimation model commonly used in digital system evaluations (Hair, *et. al.*, 2023), contextualized within the Islamic social finance domain.

In conclusion, the research methodology not only investigates the technical potential of blockchain but also provides structured insights into how it can enhance the governance, trustworthiness, and cost-effectiveness of *zakat* management systems, without compromising Sharia compliance.

Results and Discussion

The blockchain-based digital *zakat* system developed demonstrates effectiveness and efficiency in the *zakat* collection and distribution process.

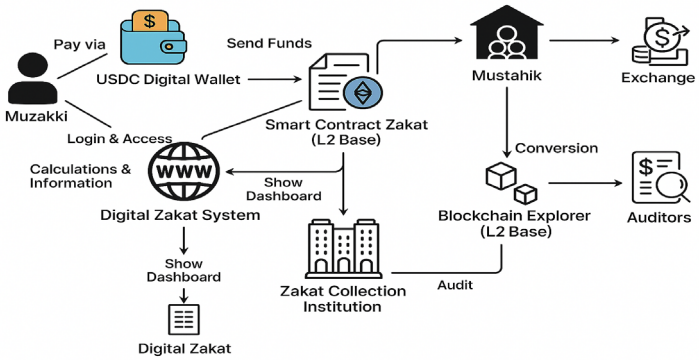

Figure 1. Blockchain-Based *Zakat* System Flow

Source: Blockchain-Based Zakat Transaction Process

The system begins with *muzakki* accessing the digital *zakat* platform via a web interface or mobile application, followed by the *zakat* calculation process and payment through a blockchain-based digital wallet. *Zakat* funds are paid using stablecoins such as USDC and sent to a *zakat* smart contract on the Ethereum Layer 2 (Base) network. This smart contract automatically records all transactions on the public blockchain, including the amount, timestamp, and sender's address.
Once the funds are received, the system automatically synchronizes with the zakat management institution's (LAZ) dashboard. The verification of *mustahiq* data is conducted off-chain by the *zakat* administrators to ensure that recipients meet the criteria of the eight *ashnaf* categories as outlined in Islamic jurisprudence (*fiqh zakat*). After the verification process is completed, the funds are distributed to each *mustahiq's* wallet according to the predetermined proportions.

Table 1. *Zakat* Fund Distribution Simulation

	Wallet Purpose	Percentage Distribution	Amount (USDC)
Fakir	0xFAKIR123...	25%	$250
Miskin	0xMISKIN456...	25%	$250
Gharimin	0xGHARIM789...	15%	$150
Fisabilillah	0xFISA321...	15%	$150
Ibn Sabil	0xIBN999...	10%	$100
Muallaf	0xMUAL111...	5%	$50
Riqab	0xRIQAB555...	3%	$30
Amil	0xAMIL000...	2%	$20
Total	-	100%	$1,000

Source: Zakat Fund Distribution Process

The results of the fund distribution simulation are presented in a table showing the allocation of $1,000 USDC to eight categories of *mustahiq*. Each category receives the following percentage: *Fakir* and *Miskin* each receive 25% ($250), *Gharimin* and *Fisabilillah* each receive 15% ($150), *Ibn Sabil* gets 10% ($100), *Muallaf* 5% ($50), *Riqab* 3% ($30), and *Amil* 2% ($20). This distribution is executed entirely by a smart contract without any manual intervention, demonstrating the system's strength in automation and the accuracy of *zakat* allocation.

Table 2. Manual *Zakat* Distribution Costs

Process	Manual *Zakat*	information
Fundraising	$10	Technical costs of collecting funds from *muzakki* directly or through manual transfer
Distribution of 8 *Mustahiq*	$50	Delivery costs to each *mustahiq* (manual: transport, logistics, etc.)
Administration/Operational Costs	$40	Includes surveys, documentation, honorary officers, etc.
Total	$100	Total distribution costs

Source: Manual Zakat Distribution Process

Table 3. Gas Fee Cost Efficiency

Process	Ethereum L1 (Mainnet)	Ethereum L2 (Base)	Efisiensi (%)
Send Funds to Contract	$2.50	$0.02	99.2%
Distribution to 8 Wallets	$10.00	$0.15	98.5%
Total	$12.50	$0.17	98.6%

Source: Cost Efficiency Process

Next, a cost-efficiency analysis was conducted by comparing the gas fees between Ethereum's Layer 1 (Mainnet) and Layer 2 (Base). The simulation results showed that sending funds to a smart contract on Layer 1 required approximately $2.50, whereas on the Base network it only cost $0.02. Similarly, distributing funds

to eight *mustahiq* wallets costs $10.00 on Layer 1 but only $0.15 on Base. The total transaction cost savings reached 98.6%, making this system significantly more efficient for large-scale implementation.

Manual *zakat* distribution typically involves a lengthy process and high operational costs. Each stage, from *mustahiq* verification and fund disbursement to reporting, is carried out physically and requires human labor, transportation, and documentation. As a result, the total cost of manually distributing *zakat* to eight recipients can reach around $100, covering expenses such as transport, logistics, field surveys, and staff compensation. In contrast, a blockchain-based *zakat* system, especially on Ethereum Layer 2 (Base), requires only around $0.17 for the same process, as all transactions are automated via smart contracts and recorded transparently on the public blockchain.

This level of efficiency demonstrates that blockchain technology not only accelerates and secures *zakat* distribution but also drastically reduces the operational costs of *zakat* institutions. The system also excels in transparency and auditability. All transactions are permanently recorded on the public blockchain and can be traced using blockchain explorers by the general public or independent auditors. This addresses the accountability issues common in conventional *zakat* management, thereby strengthening public trust in *zakat* institutions.

From a Sharia perspective, the system maintains compliance with *zakat* jurisprudence. *Mustahiq* verification is still conducted manually to ensure eligibility and validity, while the distribution process is automated with high accuracy. This combination of off-chain and on-chain approaches creates a balanced model that upholds Sharia principles while embracing technological efficiency.

Overall, the results and discussion demonstrate that a blockchain-based *zakat* system using Ethereum L2 (Base) holds great potential for implementation by *zakat* management institutions in Indonesia. Its advantages in cost efficiency, transparency, and adherence to Islamic values position it as a transformative model for digital *zakat* distribution, responding to modern needs while remaining rooted in Islamic principles.

Conclusion

The implementation of a blockchain-based digital *zakat* system using the Ethereum Layer 2 (Base) network presents a transformative approach to modern *zakat* management. By leveraging smart contracts for fund disbursement and automating transaction records on a public blockchain, the system significantly reduces operational costs achieving over 98% cost efficiency while enhancing transparency, accuracy, and auditability.

Each step in the system's design plays a strategic role: the use of stablecoins like USDC ensures value stability; the automation of transactions through smart contracts eliminates manual errors and reduces administrative workload; and manual *mustahiq* verification by certified *zakat* institutions ensures compliance with Sharia guidelines. Together, these components strengthen institutional accountability and build public trust.

More than just a technical innovation, this system represents a shift toward accountable, secure, and inclusive Islamic social finance. It enables faster, cheaper, and more reliable *zakat* distribution without compromising religious obligations. In conclusion, the proposed blockchain-based model contributes a practical and scalable framework for *zakat* institutions in Indonesia to enhance cost efficiency, improve governance, and advance equitable wealth distribution in line with Islamic economic principles.

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